5.93 S671

TECHNOLOGY

U. S. DEPARTMENT OF COMMERCE

Technical News Bulletin

of the

National Bureau of Standards

★ *Issued Monthly* ★

Washington NOVEMBER 1942[1] Number 307

CONTENTS

The building as a defense against fires from bombs.
A reexamination of the Potsdam absolute determination of gravity.
Fresnel reflection of diffusely incident light.
An improved volumenometer.
Catalyzed hydrolysis of proteins.
Characteristics of textile fibers.
Wear tests of carpets.
Effect of calcium chloride on concrete.
Glossary of housing terms.
Simplified practice recommendation for surgical gauze.
Simplified practice recommendation for forged axes.
Personnel changes.
New and revised publications issued during October 1942.
Mimeographed material.
Recent articles by members of the Bureau's staff published in outside journals.

THE BUILDING AS A DEFENSE AGAINST FIRES FROM BOMBS

The structures used as living quarters or business establishments cover a wide range, from liability to asset, so far as the fire hazard from bombing is concerned. Incendiary or combined incendiary and explosive bombing from airplanes constitutes the most advanced and effective use of fire as a weapon in warfare. The hazard is not only to the individual building, its occupants and contents, but also to the community as a whole. By the setting of a big fire or many fires, a conflagration may be created, uncontrolled and uncontrollable, except for the dearth of material to burn.

The degree of hazard to municipalities depends to a large extent on the prevailing type of building construction within a district, spacing of buildings, and their occupancy or contents. It is gauged by the amount and kind of combustibles in the building and its contents, how these are contained, confined or segregated, the effect of fire therein on the integrity of the building construction, and the extent to which the latter serves to prevent origin and subsequent spread of fire within, and communication of fire to neighboring structures.

The most effective incendiary bombing from airplanes has been with relatively small bombs weighing only a few pounds, of which a thousand or more constitute a plane load. These are made to have low penetrating power so that they will not go entirely through buildings but come to rest at some point within them. Roofs that withstand without perforation the impact of such bombs are an effective safeguard against them. The resistance of existing roofs can be increased for the purpose, or a layer of incombustible material can be placed on an attic or upper floor to stop the bomb, some of the impact energy of which has been lost in going through the roof construction. Against attacks with the larger incendiary bombs and combined attacks with demolition or high-explosive bombs and fire bombs, it may not be practical or possible to provide such structural protection.

After a fire bomb enters a building, the sequence of events is about the same as for the more common fire origins. If the building is of incombustible construction with only minor amounts of combustible contents, the consequences may not be serious so far as building and contents are concerned, since the fire is not likely to spread rapidly and it can be controlled in its initial stage. For

[1] Published with approval of the Director of the Budget.

greater amounts of combustible contents, the effect of the type of building construction is less significant, but segregation by means of closely spaced fire walls or barriers is of decided assistance in preventing the fire from getting beyond control.

The type of building construction has a very great influence in preventing communication of fire from building to building and the creation of conflagration conditions. After disastrous fires over a period of several hundred years in cities of western Europe, buildings within given distances from others were required to have masonry exterior, or exterior and interior bearing walls. This has been found to be effective in preventing sweeping fires where buildings are of moderate size with no large amounts of combustible contents. However, the Baltimore conflagration of 1904 swept through some 50 city blocks of 3- to 5-story buildings of this type, housing largely commercial occupancies. The conflagration was stopped on one side by modern fire-resistive buildings which, while damaged or partly burned out, did not communicate fire to the structures beyond them.

There have been incidents in recent warfare to indicate the superiority of incombustible fire-resistive construction in preventing excessive fire damage from bombing. Thus, Madrid, besieged with an attacking force in its outskirts for over a year, suffered comparatively little from fire, whereas important parts of Warsaw built up with masonry-walled buildings having interior wood framing were destroyed with incendiaries dropped from airplanes. The attack on the "Old City" portion of London gave similar evidence, and on other occasions general conflagrations were apparently prevented by only narrow margins. Again, Malta, the most bombed city on the face of the earth, has been able to survive because bombardments, while causing buildings to collapse, have not started fires of any consequence. This is probably because the buildings have masonry interior as well as exterior construction—a type of construction which has been the general urban building practice in southern Europe for the past few hundred years.

While it may not be possible, under present conditions in the United States, to effect structural changes that will directly decrease the community hazard, that to individual buildings can be reduced with roof and opening protections and subdivision of areas. By the same token, any measure that prevents or restricts fires in individual buildings serves also in a measure as community protection. In any case, the general protective measures should be planned with respect to the hazard presented by the particular structural conditions prevailing in a given community.

A paper on this subject was presented by S. H. Ingberg, chief of the Bureau's fire resistance section, at the 27th annual meeting of the Building Officials' Conference of America and will be published in the proceedings of that organization.

A REEXAMINATION OF THE POTSDAM ABSOLUTE DETERMINATION OF GRAVITY

In the determination of the ratio of the electrical unit of current in the present international system to the absolute unit based on the mechanical units, electrical forces are balanced against the gravitational attraction of the earth on a known mass. For accurate computation of the force in mechanical units, the local acceleration of gravity must be accurately known. The present accepted international base for gravity measurements is Potsdam, Germany, at which place a careful absolute measurement was made by Kühnen and Furtwängler in the years just preceding 1906. Values at other stations on the earth's surface are obtained by observing the time of swing of a pendulum at the base station and at the local station.

Recently, absolute determinations of gravity have been made at the National Bureau of Standards in this country and at the the National Physical Laboratory in England. The results differ from the generally accepted Potsdam value by amounts considerably greater than the probable error assigned to that value by the German investigators. A reexamination of the Potsdam determination has been made by Hugh L. Dryden, and is reported in the November Journal of Research (RP1502). This shows that the discrepancy is due in large part to an adjustment of the observations made with the intent of correcting for certain systematic errors and that the adjustment was probably not warranted. If this adjustment is not made, the Potsdam result is about 12 parts per million less than the commonly accepted value as compared with 14 and 20 parts per million less, as found in the recent absolute determinations. The best value of gravity for general use where accurate absolute values are needed is probably obtained by reducing the local value in the Potsdam system by about 15 parts per million. The Subcommittee on Gravity of the National Research

Council Committee on Fundamental Physical Constants has recommended a reduction of 17 parts per million.

FRESNEL REFLECTION OF DIFFUSELY INCIDENT LIGHT

The reflection factor of a plane boundary between two media has been computed by Deane B. Judd, using the Fresnel formula for unpolarized, perfectly diffused incident light as a function of the relative index of refraction of the media. As explained in the Journal of Research for November (RP1504), because of total internal reflection, the factors depend upon whether the diffuse flux is incident externally or internally. For example, diffuse light in air incident on the plane surface of glass of index 1.5 is 9.2 percent reflected; but if the perfectly diffuse light is incident internally, the reflection factor is 60 percent.

AN IMPROVED VOLUMENOMETER

A volumenometer has been used at the Bureau for the past 6 years to measure the solid volumes of specimens varying in size up to that of standard building bricks. In order to test the larger standard refractory bricks, a new instrument was built by J. C. Richmond, John B. Peterson, and Winslow H. Herschel in 1941. Certain changes in design were incorporated to facilitate the operation and improve the accuracy.

The chief feature of the new design is the use of a closed-cistern altitude-type mercurial barometer to measure pressures, replacing the simple manometer previously used. A vernier index permits readings to 0.1 mm of mercury.

The barometer was designed for use in a constant-temperature room (21.1° C) where the acceleration of gravity is 980.1 cm/sec.^{2}. Under these conditions, it will indicate pressures directly, and the indicated pressure, without correction, will have a maximum deviation of 0.2 mm of mercury from the actual pressure, corrected to 0° C and gravity at sea level. A barometer of this type can be designed to correct for any given conditions of temperature and gravity, or a calibration chart can be prepared for use at temperatures other than the standard.

The use of this barometer to measure pressures in the closed system eliminates inaccuracies arising from changes in atmospheric pressure during a test, and operation of the instrument in a constant-temperature room eliminates inaccuracies due to changes in temperature. The instrument is designed as a self-contained unit, and may be easily moved from place to place.

CATALYZED HYDROLYSIS OF PROTEINS

Proteins are customarily broken down into their constituent simpler components, the amino-acids, by boiling in concentrated solutions of strong acids for periods of several hours. This drastic treatment usually results in the partial destruction of some of the less stable amino-acids, which are essential to normal nutrition. Digests so prepared are of only limited use for intravenous or oral administration unless they are enriched by additions of the destroyed essential amino-acids, which greatly increases their cost. The use of these digests for accurate analysis of the original protein is also obviously impaired by the destruction incident to hydrolysis.

It has now been discovered by research associates of the Textile Foundation at the Bureau, that in the presence of certain dyes and ions derived from acids of high molecular weight, proteins are hydrolyzed at 65° C over 100 times as fast as when they are hydrolyzed by dilute solutions of hydrochloric acid alone. A rapid rate of hydrolysis is attained under considerably milder conditions than those customarily employed.

In RP1503 in the November Journal of Research, Jacinto Steinhardt and Charles H. Fugitt point out that the catalytic action of the effective ions is suggestively similar to the action of enzymes in digesting proteins. The experiments show that the catalytic effect depends on the ability of the ions to combine with groups in the proteins near the bonds that are attacked. This demonstration is used as the basis for proposing a theoretical mechanism of the acid digestion of proteins. Practical applications are suggested.

CHARACTERISTICS OF TEXTILE FIBERS

The following is an abstract of a talk by Milton Harris, research associate of the Textile Foundation, at a meeting on October 9 of the Virginia Section of the American Chemical Society at Waynesboro, Va.

The industrial application of the various textile fibers depends largely on their mechanical properties. Thus, wool is particularly suited to the fabrication of clothing, blankets, and carpets, all of which require fibers having long-range elasticity. On the other hand, cotton and high-tenacity rayons are used for

tire cords and other materials where high strength, especially at elevated temperatures, is essential. The mechanical properties of a fiber are intimately related to the chemical nature and organization of its molecular constituents. The details of this relationship are now being investigated for many of the important fibers, especially those of wool and other proteins.

It can now be shown that the important chemical, mechanical, as well as biological properties of wool, are dependent on an unusual molecular architecture. Like other proteins, wool is composed of long flexible molecular chains, but it is distinguished from most of them, as well as from other textile fibers, by the presence of covalent disulfide cross-links between these main chains. The flexibility of the molecular chains is the basis of the long-range elasticity of wool; the cross-links are responsible for much of the strength of the fiber and the suppression of plastic flow. (See TNB303, July 1942.)

The cross-links in wool are extremely susceptible to attack by a variety of chemical agents, and this primarily accounts for the ease with which wool may lose its desirable properties under certain conditions. These unstable links, however, are readily converted to a stable type of cross-link by the insertion of short hydrocarbon chains between the sulfur atoms, according to the following scheme:

$$R-S-S-R \longrightarrow R-S-(CH_2)_n-S-R.$$

The product so obtained has the desirable long-range elastic characteristic of wool but at the same time exhibits a greatly increased resistance to attack by many chemical agents, and by such biological agents as moths, enzymes, bacteria, and molds. (See TNB295, November 1941.)

Wool appears to be an excellent model for other fiber systems as well as for three-dimensional high polymeric systems in general. For example, it can be shown that in many respects wool is analogous to vulcanized rubber, whereas wool in which the cross-links have been ruptured is similar in behavior to raw rubber.

WEAR TESTS OF CARPETS

Carpets and rugs form one of the most important items of home furnishing. They should harmonize with the decorative scheme of the room, conform to the general architecture of the house, and appeal to the aesthetic demands of the occupants. Since they constitute a more or less permanent fixture, durability should be a primary consideration in their selection.

The evaluation of the durability of carpets and rugs has been thoroughly studied at the Bureau. The results of several years of tests are reported in RP1505 by Herbert F. Schiefer in the November Journal of Research. Two types of machines for testing the wear resistance of carpets, known as the NBS and the Shawmut machines, are described. Factors affecting the results of the wear tests were studied, and the effect of systematic changes in carpet construction on the wear resistance was investigated with each machine. Tests on 24 carpets of Axminster, velvet, and Wilton weaves were made on the two types of machines in several laboratories, and the results obtained in the different laboratories were compared with each other and also with the results of 3 years of severe service tests on the same carpets. The service tests were conducted in a corridor of the Federal Warehouse, Washington, D. C. Over 2,000,000 persons walked over the carpets during these tests. Three types of vacuum-cleaning systems were used, and their effect on the wear of the carpets and the effectiveness of cleaning were observed. Three different wear indices for evaluating the relative wear of carpets were considered. The nature of the wear produced by the two machines on the pile fibers of carpets was found to be similar to that produced during the service tests. The excellent correlation between the results of the machine tests and the tests in service is highly significant, and shows the relative wear of carpets can be evaluated by means of laboratory tests. However, for interlaboratory comparison, the testing machines and the testing procedures must be rigidly standardized and controlled.

EFFECT OF CALCIUM CHLORIDE ON CONCRETE

A study of the effect of calcium chloride on the strength of concrete made from mixes of low water content was completed a short time ago by J. C. Yates and C. R. Cornthwaite, research associates of the Calcium Chloride Association. The following abstract is based on a paper which they have prepared for the Highway Research Board.

Compressive strength data were obtained on concrete cylinders prepared in the laboratory from mixes having water contents of 6.5 to 3.5 gallons per bag of cement and containing 0, 1, and 2 percent of calcium chloride. Increasing the amount of calcium chloride resulted

in increasing the strengths of the concretes, particularly at the earlier ages.

Strength measurements were made also on concrete block and pipe prepared with and without calcium chloride at a local concrete-products plant. In these experiments the mix (containing approximately 3 gallons of water per bag of cement) was the same as that regularly used at this plant for both products. Furthermore, the plant practices of mixing, molding, and curing were followed. Additions of calcium chloride increased the compressive strength of the block and the crushing strength of the pipe.

GLOSSARY OF HOUSING TERMS

A committee composed of members of various Federal housing agencies has compiled a glossary of housing terms in which is presented a large number of expressions found in the literature. This has just been published as Building Materials and Structures Report BMS91, the object being to bring together, for the convenient use of all persons concerned with housing, definitions that are generally accepted and currently used. This is a revision and expansion of a publication issued in 1937. Additions are most extensive in the fields of landscape and construction work, where considerable confusion exists regarding many definitions. It is hoped that, from time to time, the document can be further improved, so that it will always be up to date and of maximum value.

Copies are obtainable from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 15 cents each.

SIMPLIFIED PRACTICE RECOMMENDATION FOR SURGICAL GAUZE

With a view to insuring adequate production of surgical gauze for war and civilian needs during the emergency, the War Production Board requested the Bureau's Division of Simplified Practice to assist the manufacturers of gauze in further simplifying the variety of products covered by Simplified Practice Recommendation R86. The Division therefore cooperated with the standing committee in preparing an emergency revision of the recommendation which was approved by all the manufacturers and a representative group of distributors and users.

This latest revision eliminates all put-ups in two high-count weaves and two put-ups in a low-count weave, and adds one low count weave to meet requirements for that construction. As a result of these changes, 25 surgical gauze put-ups, in 100-yard bolts, will be manufactured for regular stock, compared with 30 formerly being produced.

The chairman of the standing committee points out that this simplification will have the effect of concentrating production on the weaves and put-ups most urgently needed at present by the hospitals and armed forces, and that the changing over of some looms from close weaves to more open weaves will bring about an increase in volume of production.

No changes were proposed by the standing committee with respect to crinoline, bandage rolls, gauze bandages, and gauze in sealed cartons.

The revised recommendation, designated as R86–42, became effective on September 1, 1942. Until the printed edition is available, free mimeographed copies may be obtained from the Division of Simplified Practice, National Bureau of Standards, Washington, D. C.

SIMPLIFIED PRACTICE RECOMMENDATION FOR FORGED AXES

As part of its broad program of simplification to conserve metals and materials by the elimination of nonessential types and sizes of commodities, the War Production Board requested the Bureau to work out a further simplification of the line of forged axes shown in Simplified Practice Recommendation R158–41.

Therefore, last June a proposed revision was prepared, which, with some amendments, was approved by the Forged Ax, Hatchet, and Hammer Industry Advisory Committee, and issued by the War Production Board as part of Schedule II of Limitation Order L–157, Hand Tools Simplification, effective from November 17, 1942. It was also approved as an emergency revision of Recommendation R158–41.

Under the revised program, 150 varieties of axes (counting patterns, styles, grades, and sizes) may be manufactured, instead of the 382 varieties which the industry has been producing. This represents a reduction of 61 percent. The smaller number of types and sizes permitted will tend to speed up production, eliminate inventories of special sizes and shapes of steel, and bring about a more rapid rate of turnover of finished products, with inventories reduced to a minimum. The use of all alloy steels will be eliminated.

After the emergency, Recommendation R158 will again be subject to regular review for revision or reaffirmation by the standing committee.

PERSONNEL CHANGES

W. H. Swanger, assistant chief of the Division of Metallurgy, and for 12 years in charge of the section on mechanical metallurgy, died on August 19, after a long illness. J. G. Thompson, chief of the chemical metallurgy section, has been appointed assistant chief of the Division, and William F. Roeser of the Heat and Power Division has been appointed chief of the section on mechanical metallurgy. Mr. Roeser has been a member of the Bureau's staff for 22 years and has achieved wide recognition in the field of high-temperature measurements. He has naturally worked in close cooperation with the Metallurgy Division, and many of his publications have dealt with the thermal properties of metals and alloys.

The vacancy caused by the death of Alfred N. Finn, chief of the glass section, which occurred on September 21, has been filled by the appointment of C. H. Hahner, who has been in charge of this important section, since Mr. Finn was obliged to give up active work a year ago. The far better position of this country as regards optical glass at the beginning of the present war as compared with World War I was at least partially due to the active research and continued production of the Bureau's glass section during the intervening years under Mr. Finn's able direction.

On September 30 Dr. Campbell E. Waters, assistant chief of the Chemistry Division and chief of the organic chemistry section, retired after 38 years of distinguished service at the Bureau. His fundamental work on lubricating and other oils, inks, carbon paper, and typewriter ribbons is well known; he was granted a patent, dedicated to the free use of the public, for a quick-drying stamp-pad ink. For many years he served on numerous committees charged with the drafting of Federal specifications. Following Dr. Waters' retirement, Dr. Edward Wichers, chief of the section on reagents and the platinum metals, was appointed assistant chief of the Division, and W. Harold Smith has been made chief of the organic chemistry section. Mr. Smith has made valuable contributions to the chemistry of rubber, which have been the subject of numerous items in this Bulletin.

NEW AND REVISED PUBLICATIONS ISSUED DURING OCTOBER 1942

Journal of Research[2]

Journal of Research of the National Bureau of Standards, volume 29, number 4, October 1942 (RP1499 to RP1501, inclusive). Price 30 cents. Annual subscription, 12 issues, $3.50.

Research Papers[2]

[Reprints from the August and September 1942 Journal of Research]

RP1494. X-ray measurement of the thickness of the cold-worked surface layer resulting from metallographic polishing. Herbert C. Vacher. Price 10 cents.

RP1495. Provisional pH values for certain standard buffer solutions. Roger G. Bates, Walter J. Hamer, George G. Manov, and S. F. Acree. Price 5 cents.

RP1496. Surface available to nitrogen on bone black and other carbonaceous adsorbents. Victor R. Dietz and Leland F. Gleysteen. Price 10 cents.

RP1497. Preparation of lower aldonic acids by oxidation of sugars in alkaline solution. Horace S. Isbell. Price 5 cents.

RP1498. Characteristics of wide-angle airplane-camera lenses. Francis E. Washer. Price 5 cents.

Building Materials and Structures Reports[2]

[Persons who wish to be notified of new publications in the Building Materials and Structures series as soon as they are available should write to the Superintendent of Documents, Government Printing Office, Washington, D. C., asking that their names be placed on the special mailing list maintained by him for this purpose.]

BMS91. A glossary of housing terms. Compiled by subcommittee on definitions, Central Housing Committee on Research, Design, and Construction. Price 15 cents.

Technical News Bulletin[2]

Technical News Bulletin 306, October 1942. Price 5 cents. Annual subscription, 50 cents.

[2] Send orders for publications under this heading only to the Superintendent of Documents, Government Printing Office, Washington, D. C. Subscription to Technical News Bulletin, 50 cents a year; Journal of Research, $3.50 a year (to addresses in the United States and its possessions and to countries extending the franking privilege; other countries, 70 cents and $4.50, respectively).

MIMEOGRAPHED MATERIAL

Letter Circulars

[Letter Circulars are prepared to answer specific inquiries addressed to the National Bureau of Standards, and are sent only on request to persons having a definite need for the information. The Bureau cannot undertake to supply lists or complete sets of Letter Circulars or send copies automatically as issued.]

LC704. Optical instruments, refractometry, and optical properties of glass. (Supersedes LC673.)

LC705. List of commercial standards. (Supersedes LC695.)

RECENT ARTICLES BY MEMBERS OF THE BUREAU'S STAFF PUBLISHED IN OUTSIDE JOURNALS [3]

An ounce of prevention is worth a pound of cure. S. H. Ingberg. Domestic Commerce (Dept. of Commerce, Washington, D. C.) **30**, No. 14, 8 (Oct. 1, 1942).

The precision of motor fuel testing. Donald B. Brooks and Robetta B. Cleaton. Soc. Automotive Engineers J. (29 West 39th St., New York, N. Y.) **50**, No. 9, 392 (Sept. 1942).

Photoelectric tristimulus colorimetry with three filters. Richard S. Hunter. J. Optical Soc. Am. (175 Fifth Ave., New York, N. Y.) **32**, 509 (Sept. 1942).

A metallurgical study of the formation of austenite from aggregates of ferrite and cementite in an iron-carbon alloy of 0.5 percent carbon. T. G. Digges and S. J. Rosenberg. Preprint 20, Am. Soc. for Metals (7301 Euclid Ave., Cleveland, Ohio) (Sept. 1942).

Influence of initial structure and rate of heating on the austenitic grain size of 0.5-percent carbon steels and iron-carbon alloy. T. G. Digges and S. J. Rosenberg. Preprint 21, Am. Soc. for Metals (Sept. 1942).

The effect of moderate cold rolling on the hardness of the surface layer of 0.34-percent carbon steel plates. H. K. Herschman. Preprint 34, Am. Soc. for Metals (Sept. 1942).

Proliferous Scott's Spleanwort. C. E. Waters. Am. Fern J. (N. Queen St. and McGovern Ave., Lancaster, Pa.) **32**, 109 (July–September 1942).

[3] These publications (unless otherwise stated) are not obtainable from the Government. Requests should be sent direct to the publishers.

U. S. GOVERNMENT PRINTING OFFICE: 1942

PUBLIC LIBRARY
NOV 23 1942
DETROIT